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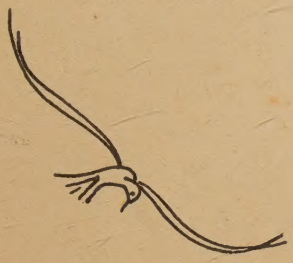

INDIAN FISHERIES BULLETIN

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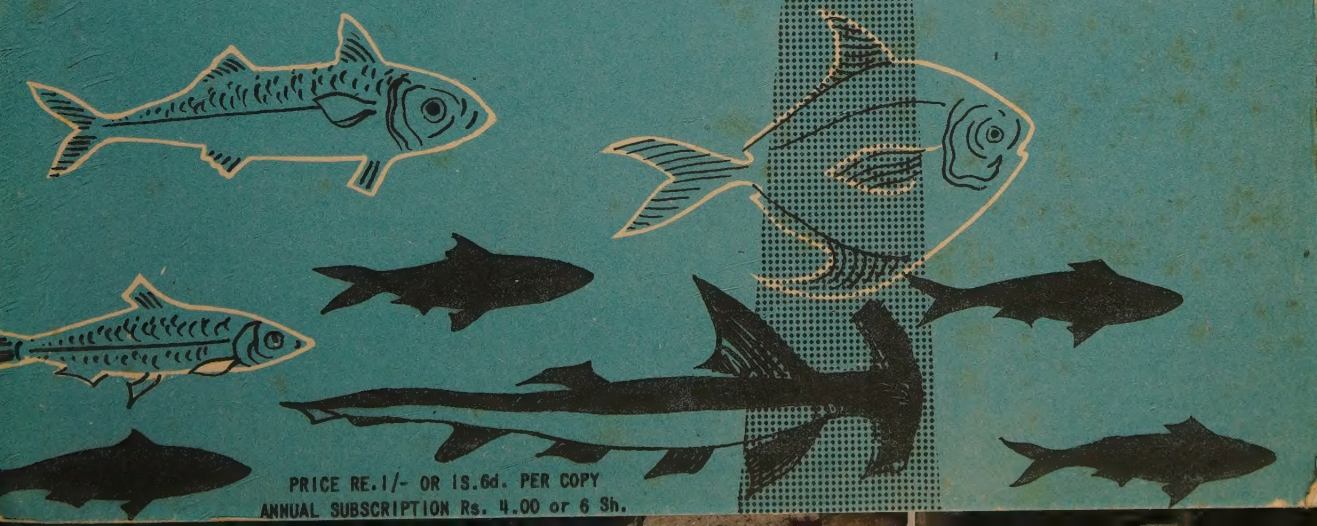

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INDIAN

GENERAL AND DEVELOPMENT

The Recommendations of the Committee on Fisheries Education

The Government of India in the Ministry of Food and Agriculture set up a Committee on Fisheries Education to examine the question of existing training facilities in India and to consider the establishment of a higher training institute for supervisory personnel for fisheries. The Committee made the following recommendations:

Man power Deficiency

(1) The Committee is convinced that progress in development of Indian Fisheries has been hampered by acute shortage of suitably trained personnel. Shortages of operatives and lower level administrative staff have been partially overcome by training provided by Government but no training exists for high level development and managerial staff. Accelerated development during the Third and successive Plans will not be achieved without such trained staff. The Committee recommends that immediate steps be taken to establish facilities for this training.

(2) Such training along with certain other ancilliary training courses in fisheries should be organised by the Central Government (Ministry of Food and Agriculture) in an Institute which should be established for this purpose and not as an adjunct to any of the existing establishments or Universities.

Interim arrangements.—(3) The Committee reiterates and recommends for adoption its proposal made in an Interim Report that pending the establishment of this Institute, immediate arrangements be made at Bombay for a provisional training course for District Fisheries Development Officers. The Committee recommends that this course should start in July, 1959.

Status of the Course.—(4) The provisional course of study prescribed for the District Fisheries Development Officers should develop into a regular professional training in Fisheries, which should be on a par with the Bachelor Degree Course in Agriculture, Forestry and other applied sciences. Although starting as a Diploma Course, this should eventually become a Degree Course in Fisheries at Bachelor level.

Scope for specialisation.—(5) Having fully examined whether separate training should be provided for marine and inland fisheries, the Committee recommends that the proposed course at the Fisheries Training Institute should be common for both marine and inland fisheries. The course should, however, provide for specialisation in one of the following subject or any other subject within the curriculum approved by the Institute:—

(i) Inland Fisheries.

(ii) Fish Handling and Processing Technology.

(iii) Fishing Gear Technology.

(iv) Fishery Economics and Business Management.

(v) Fish Marketing and Trade.

Qualification for Admission.—(6) Minimum educational qualification for admission to the training course for District Fishery Development Officers should be a Degree in Science with Zoology as one of the subject. Preference should be given to those who have taken Chemistry, Botany, Statistics or Economics as an additional subject.

Duration of Training.—(7) The duration of the training course should be two years, of which nearly half should be spent in prescribed field work.

Number of Trainees.—(8) To meet the requirements of trained personnel in the Third Plan, the Committee's opinion is that at least 30 candidates should be trained at the Institute each year. If the Institute becomes a regional or an international training centre, steps should be taken to ensure that adequate number of seats are reserved for Indian trainees.

Selection of Trainees.—(9) The trainees should include nominees of Central and State Governments as well as private candidates. For the first two or three batches of trainees, it is expected that all seats will be taken up by Governmental nominees.

Nominations.—(10) The trainees nominated by the State Governments should include persons either already in service or selected against existing or anticipated posts.

Stipends.—(11) The trainees should be given stipends during the period of training and also provided with adequate travel grants. The Committee recommends a stipend of Rs. 200 per month. Employees of Central/State Governments should be paid full salary and allowances and if the total emolument is less than the Stipend, they should be given additional allowance upto the prescribed stipend.

Location of Institute.—(12) Having studied the various criteria necessary for the successful functioning of the Training Institute, the Committee feels that the Institute should be located at a centre where the fishing industry is well developed and where adequate port facilities are available for the ships of the Institute. Since the main centre of training must thus be a coastal city, the Committee recognises the need for a sub-centre at which to give field training in inland fish cultural practices.

(13) On strictly technical grounds the Committee considers that Cochin is the most suitable place for the location of the Training Institute.

(14) For the location of the Inland Fisheries Training Sub-Centre, the Kausalyaganga area near Bhubaneswar in Orissa offers the best facilities.

Physical facilities.—(15) The Institute should have its own library, workshop, training ships, pilot processing plants, laboratories, lecture rooms and other essential facilities for a self-contained training establishment.

(16) It is most essential to provide hostel facilities for the trainees, regardless of the location of the Institute.

(17) If the Institute is situated at some distance from the city, residential accommodation for all members of the staff should be provided in the vicinity of the Institute. In any case, it would be necessary to provide accommodation for the Director and a part of the staff in the premises of the Institute.

Training Vessels.—(18) The Training Institute should have two vessels—one capable of being used for different types of fishing, about 85 to 90 feet and the other, a smaller vessel of about 35 feet. These ships should have berthing and servicing facilities within a reasonable distance from the Institute. Both the

vessels should be staffed by competent personnel and fully equipped for fishing with different kinds of gear, exploratory work and training. It is likely that the services of a skipper and a Senior Engineer for the larger vessel will have to be obtained from abroad for a period of three years.

Staff.— (19) The Committee places great emphasis on the high professional standing of staff to be appointed for the Institute. It should have a Director, who will be in charge of the whole organisation, assisted by a Registrar to help him in purely administrative matters. There should be one Professor for each of the following Divisions:—

(1) Fishery Biology.

(2) Fishery Economics and Cooperation.

(3) Fishery Technology,

(20) There should be six Assistant Professors for the subjects indicated below:—

A. *Division of Fishery Biology.*

(1) Oceanography, Meteorology and Limnology.

(2) Inland Fisheries.

B. *Division of Fishery Economics.*

(1) Statistics, Commerce and Business Administration.

(2) Marketing and Co-operation.

C. *Division of Fishery Technology.*

(1) Fishing Technology and Naval Architecture.

(2) Fish processing and related subjects.

(21) In addition to the Assistant Professors, there should be demonstrators, field instructors, administrative personnel, Secretarial Staff, etc.

(22) The Committee considers that it will be necessary to engage experts from abroad to occupy the senior posts at the Institute during its formative years. Suitable Indian counterparts should be appointed to work with the foreign experts and be trained by them to take over the responsibilities within a period of about five years.

(23) In addition to the permanent staff of the Institute, the Committee envisages the need for visiting lecturers from India and abroad for giving special course.

Placement of qualified Trainees.

(24) The trainees after successful completion of the course should normally be eligible for appointment as District Fisheries Development Officers. In some cases, it may be necessary for administrative reasons to appoint them initially to lower posts such as Inspectors, but there should be a reasonable prospect of their promotion as District Officers in 3 to 5 years.

(25) To attract good trainees, fisheries positions in Government service should have adequate remuneration. The status and salaries of District Fisheries Development Officers should, by no means, be lower than those prescribed for corresponding position in Agriculture or Forestry. The Committee wishes to emphasise that in its view much of the purpose of the Institute would be nullified if candidates of the right kind do not come forward for training.

Training of Junior Fisheries Officers

(26) To meet the requirements of staff at levels lower than that of the District Fisheries Development Officer in Inland States and for inland areas in maritime States, the existing training course at Barrackpore should be suitably overhauled. For this purpose, additional staff will have to be provided and the syllabus revised to give more practical training in inland fisheries. When facilities become available at the proposed sub-Centre of the Institute at Kausalyaganga, this course should be transferred to that place.

Operatives Training.

(27) The Committee is convinced that there is great need for training operatives at various levels of skill in fishing, navigation, boat-building, marine engineering, fish handling and processing, marketing etc. Training in these skills should be separate from the training for Development Officers. For such vocational training, preference should be given to fishermen wherever possible.

(28) The Committee recommends that in addition to the training for Fisheries Development Officers the Institute should conduct or arrange for certain courses in subjects ancillary to fisheries.

MARINE.

(i) Prawn Fisheries in India

The prawn fisheries of India constitute a very important and valuable fishery. The average annual production based on the average of the past few years works out to roughly 1,00,000 tons (22,40,00,000 lbs.). The quantity landed is second to that of U.S.A. where the average landings are between 140 and 150 thousand tons. Of the quantity landed roughly 60 per cent is converted into dry prawn pulp, which is exported largely to Burma and a few Eastern countries. About 25 per cent is consumed in fresh condition. The balance is largely processed into frozen prawns and canned prawns.

The prawn freezing and canning industries are of a recent origin. There are about 18 units in all, in Cochin, Calicut, Mangalore and Bombay. The production of these factories is steadily mounting up and the products are largely exported to U.S.A. The foreign exchange earned by these factories during the year 1959, came to Rs. 50 lakhs.

The prawns taken from the estuarine waters constitute the major percentage of the total quantity landed. Various types of gear such as the cast net, the Chinese dip net and the stake nets are employed to catch the prawns.

(Central Fisheries Technological Research Station, Cochin.)

(ii) Production of Fish Meal in India

	1958-59	1959-60
Kerala		
Fish Guano	17,775 mds.	5,060 mds.
Fish meal	30,417 lbs.	12,000 lbs.
Orissa		
Fish meal	9,736 lbs.	5,510 lbs.
	1958	1959
Madras		
Fish meal	135 lbs.	152 lbs. (on an experimental scale)
Mysore		
Fish Guano	180 tons	720 tons.
West Bengal		
Fish meal	12,422 lbs.	17,056 lbs.
Bombay		
Fish meal	4000 to 5000 tons annual production.	

(iii) The Government of India Quick Freezing and Cold Storage Plant at Bombay

The income realised during the period from July, 1960 to September, 1960 from (1) Sale of ice, (2) Basket storage of fresh fish, (3) Freezing charges of fresh fish and (4) Frozen fish storage rental are as follows :—

Activity	Value realised	
	Rs.	nP.
(1) Sale of ice (803 tons 8 Cwt. 94 lbs.)	26,264	.59
(2) Basket Storage of fresh fish	8,136	.17
(3) Freezing Charges of fresh fish	5,712	.00
(4) Frozen Fish Storage Rental	11,243	.22
TOTAL	51,355	.98

(iv) Government of India Deep Sea Fishing Stations—Bombay, Cochin, Tuticorin and Visakhapatnam

During the quarter ending September, 1960 the exploratory fishing operations of the Government of India Deep Sea Fishing Stations are as follows:—

Name of the Vessel	No. of days absent from Port	Quantity of fish caught			Catch/days' absence			Value realised	
		Tons	Cwt.	Lbs.	Tons.	Cwt.	Lbs.	Rs.	nP.
Bombay (From May to September, 1960)									
M.F.V. Bangada	39	26	9	12	0	14	9	9,423	.25
M.F.V. Jheenga	77	62	19	45	0	16	39	18,761	.75
M.L. Sagar Pravasi	27	4	1	71	0	3	3	1,365	.00
M.L. Meera	31	8	15	72	0	5	75	3,131	.00
M.L. Sagarkanti	4	0	1	58	0	0	42	48	.25
M.F.V. Bumili	55	16	10	99	0	9	71	8,998	.62
M.F.V. Champa	51	19	12	18	0	7	77	10,077	.50
M.L. Sagar Vihari	No Fishing due to repairs.								
Cochin. (From March, 1960 to Sept. 1960).									
M.T. Pratap	70	102	12	46	1	9	36	29,284	.48
M. L. Durga	78	89	5	17	1	1	9	27,357	.20
M. V. Samudra	71	60	10	9	0	17	5	19,644	.93
M. V. Tarpon	54	45	18	63	0	17	1	13,060	.82
Tuticorin.									
M. V. Sagar Sundari	63	18	1	37	0	5	82	3,502	.15
M. V. Sardinella	24	0	19	46	0	0	91	327	.31
M. V. Meenakshi	63	3	1	6	0	0	109	1,356	.69
M. V. Meenalochani	58	24	11	68	0	8	53	4,063	.13
Visakhapatnam.									
M. T. Ashok	29	25	2	62	0	17	37	9,881	.87
M. V. Sea Horse.	31	5	18	25	0	3	91	2,745	.62
M. V. Gudjon	29	6	6	53	0	4	40	3,284	.87
M. V. Sagar Kumari	34	4	4	81	0	2	55	1,854	.75
Dan No. 1	58	4	2	49	0	1	47	2,485	.25
Dan No. 2	54	3	4	90	0	1	22	2,064	.00

(v) Report on the exploratory fishing operations of the vessels of the Deep Sea Fishing Station and offshore Fishing Units during 1959-60

Name of the Vessel	No. of days fished	Quantity of fish caught	Value realised
		Tons. Cwt. lbs.	Rs. nP.
BOMBAY			
M. F. V. Bangada	80	70 9 89	20,472 .50
M. F. V. Jheenga	159	131 18 95	35,118 .76
M. L. Meera	138	85 8 14	7,664 .20
M. L. Sagar Kanti	84	13 6 19	5,202 .00
M. F. V. Bumili	120	150 7 19	13,262 .50
M. L. Sagar Pravasi	62	11 12 54	2,981 .50
M. F. V. Champa	17	4 15 5	1,317 .50
		Quantity of fish caught in lbs.	
COCHIN.			
M. T. Ashok and M. T. Pratap	29	2,68,150	22,204 .03
M. L. Durga	149	3,55,268	44,323 .61
M. V. Tarpon	135	2,75,219	35,495 .65
M. V. Samudra	140	2,40,021	3,142 .16
M. T. Pratap	74	3,62,346	36,749 .81
M. V. Samudra & M. V. Tarpon	7	6,110	102 .80
M. L. Durga & M. V. Flying fish	7	8,009	989 .59
TUTICORIN			
M. V. Sardinella	94	15,826	3,888 .26
M. V. Sagar Sundari	86	11,233	2,527 .72
M. V. Sagar Kumari	91	14,651	2,085 .30
M. V. Meenalochani	39	528	181 .42
M. F. V. Gudjon	23	2,993	485 .61
M. V. Meenakshi	100	12,034	3,554 .37
VISAKHAPATNAM.			
M. T. Ashok	54	89,462	8,438 .25
M. V. Sea horse	25	4,432	18 .25
M. V. Sagarkumari	24	99,209	491 .50

(vi) The landings of four bull trawlers of New India Fisheries Ltd., Bombay for the quarter ending September, 1960

Name of the Vessel	Period of Voyage	No. of days absent from port	Quantity caught (tons)	Catch/days absence (tons)	Depth Fished (metres)
(1)	(2)	(3)	(4)	(5)	(6)
'Arnalla' & 'Paj'.	2-7-60 to 13-7-60	12	53	4.4	42—60
	15-7-60 to 25-7-60	11	64	5.8	42—62
	27-7-60 to 6-8-60	11	51	4.6	40—60
	8-8-60 to 19-8-60	12	60	5.0	38—45
	20-8-60 to 31-8-60	12	58	4.8	28—44
	1-9-60 to 12-9-60	12	62	5.1	30—40
	13-9-60 to 23-9-60	11	65	5.9	36—40
	25-9-60 to 3-10-60	9	64	7.1	36—41
'Satpati' & 'Pilotan'.	27-6-60 to 8-7-60	12	49	4.1	40—63
	10-7-60 to 20-7-60	11	63	5.7	42—56
	22-7-60 to 1-8-60	12	50	4.1	43—62
	3-8-60 to 15-8-60	13	50	3.9	28—56
	16-8-60 to 27-8-60	12	54	4.5	31—56
	28-8-60 to 8-9-60	12	62	5.2	28—44
	9-9-60 to 19-9-60	12	57	4.7	30—37
	21-9-60 to 29-9-60	9	66	7.3	30—38

(vii) **Operations of the West Bengal Fisheries Trawlers Kalyani I-V. during 1959-60**

A total number of twentysix voyages were performed by the West Bengal Fisheries Trawlers II-V during 1959-60. The details of the fish catch of the different vessels are:—

Name of Vessel	No. of voyages	Fish Catch (in Kg.)			Total catch (in Kg.)
		'A' Class	'B' Class	'C' Class	
Kalyani II	6	531.00	83515.87	254.46	84301.33
Kalyani III	7	4358.31	49991.45	1584.16	56933.92
Kalyani IV	7	893.39	27656.45	1926.31	30476.15
Kalyani V	5	1436.00	61757.98	2813.92	66007.90

The Black Pagoda area is the most productive fishing ground. Analysis of the catch composition of the important groups of fishes of the different offshore fishing areas indicate that each of these areas is dominated by different groups of fishes. *Sciaena* spp. and Glass fish (*Kurtis indicus*) occur in large quantities in Sand Head, off Mahanadi, Devi and Prachi rivers. Fourteen species of Sciaenids were obtained of which the commonest forms were *Sciaena glauca, S. carutta* and *S. aneus*. The other Sciaends are identified as *Sciaena*

diacanthus, S. axillaris, S. bleckeri, S. semiluctosu, S. coibor, Sciaenoides brunneus, S. microdon, Otolithus ruber, O. argenteus, Umbrina russelii and U. macropterus. Pomfrets and other small perches formed the major catch of Black Pagoda. Though the three varieties of Pomfrets are available, the commonest species is *Pampus argenteus.* The major catches in False Bay are clupeids; the common forms are *Pellona indica, P. elongata, Engraulis telara* and *Raconda russellina.* 'Swatch of no grounds' is noted for quality fishes such as species of *Lutjanus, Parastromateus* and *Pomadasys.*

The total quantity of fishes landed during this year were 2,37,719.30 Kg. The details of the catch composition of the different species of fishes are:—

	Species of fish	Wt. in Kg.	Percentage to the respective class total.
A. Class	Pomfrets	4981.66	69.02
	Penaeus spp.	1913.44	26.51
	Cybium spp.	47.00	0.65
	Eleutheronema tetradactylum	49.00	0.68
	Pomadasys spp.	188.00	2.60
	Drepane punctata	6.00	0.08
	Lutjanus spp.	24.00	0.33
	Pseudosciaena	9.00	0.13
		7218.70	
B. Class.	Perches	3545.00	1.59
	Clupeoids	23463.59	10.53
	Polynemus spp.	192.00	0.09
	Leiognathus spp.	12811.06	5.75
	Sciaena spp.	149767.87	67.18
	Caranx spp.	22.00	0.01
	Upeneus spp.	1868.39	0.84
	Kurtis indicus	14262.32	6.40
	Lactarius lactarius	761.09	0.34
	Ephippus orbis	37.00	0.02
	Synagris japonicus	90.00	0.04
	Small prawns	297.00	0.13
	Miscellaneous.	15804.43	3.08
		222921.75	
C. Class.	Trichiurus sp.	148.80	2.00
	Muraenesox talabanoides	2113.06	27.84
	Harpodon nehereus	1319.20	17.41
	Pristis sp.	149.00	2.00
	Cat fish	2499.75	33.00
	Sharks & Rays	431.54	5.70
	Flat fishes	28.00	0.37
	Shrimps incl. Acetes	889.50	11.68
		7578.85	
	Grand Total	237719.30 Kg.	

Fish landings are more during the winter season, December and January being the most productive periods when 139119·10 Kg. were obtained which formed more than half the total landing for the year. A gradual decrease in the catch was noted after January right through to April. No fishing activities were undertaken by the trawlers during the monsoon periods May—July.

Sciaenids formed the most important catch constituting 63 per cent. of the total; a peak period in the abundance of Sciaenid fishing was noted in the month of January. There was remarkable increase in the fishery of clupeoids in January constituting the next important catch while Glass fish showed an appreciable decrease in the catch during the year.

The activities of the fishing trawlers were confined to Western Channel, S.W. of Puri Cost, mouth of Chilka, off Devi and off Prachi, Black Pagoda, off Mahanadi and False point at a depth of 3-30 fathoms.

(Central Marine Fisheries Research Station, Mandapam).

(viii) Review of the work of the Indo-Norwegian Project during the period April—June, 1960

Good work in fisheries has been done in Kerala under the Indo-Norwegian Project.

FISHING SECTION

Fishing Experiments.

The four medium boats and 'Ashtamudi' continued trawling from Cochin till the commencement of South West monsoon by the middle of June. Experimental trawling indicated the abundance of prawns from 8 to 12 fathoms line South West of Cochin. Exploratory trawling was also conducted by 'M-6' and "Flying fish" from Asthamudi outlet at Quilon.

The total landings at Cochin was 1,24,603 kgs, including 61,884 kgs. prawns with a total value of Rs. 36,088.99 np. The average catch per fishing day, per haul and per fishing hour was found to be 509 kgs., 177 kgs., and 152 kgs. respectively. The landings at Quilon were 41,443 kgs. of value Rs. 15,964.01 nP. The total landings at Cochin and Quilon during the quarter was 1,66,046 kgs., as against 92,747 kgs. during the corresponding period of 1959 showing an increase of 73,299 kgs.

The catch by 22 ft. mechanised boats in the Project Area was 78,670 kgs. valued at Rs. 27,267 as against 786 kgs. of fish of value Rs. 280 during the corresponding period of 1959. The catch by 25 ft. mechanised boats during the quarter was 30992 kgs. valued at Rs. 14,939. The average gross income of a 25 ft. mechanised boat was found to be nearly half the times higher than that of a 22 ft. mechanised boat.

Boat Building, Maintenance and Overhauling etc.

The construction work of nine 25 ft. INP boat, 23½ ft. ovald boats and 36 ft. 'M' boats (stern trawlers) progressed well. A contract for the construction of a 92 ft. steel research vessel was made and the ship is expected to be completed before the end of 1961.

With the approach of the South West monsoon fishing operations were stopped in the middle of June and annual repairs and maintenance of the vessels, equipment and gear etc. were started. The overhauling, repairs and replacement of parts of electronic and electrical equipment of the INP boats and vessels were carried out.

Refrigeration

1,48,750 kgs. of ice was produced during the quarter and 1,47,725 kg. of ice was sold realising Rs. 7,386.

A quantity of 40176 kgs. of fish and 1313 kgs. of prawns were added during the quarter to the previous balance of 5270 kgs. of fish and prawns and the total quantity were issued for marketing.

Marketing.

During the quarter 46,662 kgs. of fish were disposed of from Quilon in different interior markets of the State and the price realised amounted to Rs. 18,089. The main routes attempted were Tiruvella—Kottayam, and Kottayam—Kumali. The Quilon—Shencottah and Trivandrum—Shencottah routes proposed could not be opened due to short landings of fish.

Research.

R/V 'Kalava' undertook a research cruise from 18th to 22nd April covering an area of 70 X 40 sq. miles between Calicut and Cannanore.

Health Section.

The activities of the Health Section have been continued at the Maternity ward, Preventive and Curative Clinics, Family Planning clinic and in school health work. 79 small pox vaccinations were given. 705 persons were tuberculin tested and 458 B.C.G. vaccinated. In total 199 school children were examined.

A survey has been started by the social worker on the types of houses, conditions of the latrines and infant mortality rate among the population. Film shows were arranged regarding the prevention of the most common communicable diseases. Arrangements have been made for the working of an adult education scheme in the Project Area.

Construction work.

Planning works of the slipway, mechanical workshop, carpenters' shop, Saw Mill, Office buildings, Freezing plant and cold storage, Fish Receiving, Packing and Processing Hall, Fish boxes shed, Boiler House, and Welfare building of the INP Fishery Station at Ernakulam were in progress. The construction of the automobile repair section was started. About 26,288 ft. of water supply pipe has been laid and the purification plant at Sasthamcottah was completed.

Administrative matters.

Mr. Borge Christensen, Instructor in beach landing and Mr. John Syvertsen, skipper left for Norway on termination of their assignment.

Expenditure.

The Norwegian expenditure in India and in Norway during the quarter was Rs. 2,35,250 and Rs. 2,37,850 respectively bringing the total to Rs. 224,01,800 while the Indian expenditure was Rs. 1,23,220 which brought the total to Rs. 25,56,425. The revenue realised was Rs. 69,188.

INLAND.

(i) Fish Breeding Experiments

Production of the fish seed of Major carps was undertaken on a large scale during the period July—September 1960 in Assam State and at Cuttack in Orissa. In Assam a total of 10 lakhs of fish seed was produced. At Cuttack fish seed was produced on a commercial scale. At Cuttack in addition to producing fish seed a number of experiments were conducted in order to effect improvement in the technique of fish seed production by pituitary hormone injections. A total of one crore and 32 lakhs of fish seed was produced, out of which 82 lakhs of fry were obtained, part of which was stocked for experimental purposes

Weed Control—Spraying 'Fernoxone' in a tank infested with Eichornia

Mechanical deweeding

and the rest given over to the Orissa Fisheries Department. Factors concerning the mortality at the early phase of development of the egg and spawn were very carefully studied. Of the seed produced by induced breeding about 70% was of Rohu, 20% of Catla and 10% Mrigal and Calbasu. Two officers of the Bombay Fisheries Department were specially trained in this work.

Inter-specific as well as inter-generic hybrids of Major Indian Carps produced two years ago were observed to have attained sexual maturity. The hybrid of Rohu and Calbasu was successfully induced to breed by hormone injections.

The demand for the fry of common carp was met by producing the fry of common carp as and when required. About 7 lakhs of fry was produced.

(Central Inland Fisheries Research Station, Barrackpore)

(ii) Deep Water Fishing Experiments

Deep water fishing experiments were conducted in the Krishnaraja Sagar reservoir in Mysore State, in collaboration with the Lacustrine Unit of this Research Station, the Extension Unit and the State Department. The experiments have yielded some results which would be helpful in selecting suitable types of gear for fishing in reservoirs. One of the findings at Krishnarajasagar was that, if successful exploitation of the reservoirs is to be conducted, it is necessary to select the mesh size of the gill nets on the basis of the species of fishes occurring in the reservoirs. Uniform mesh size will not serve the purpose of successful exploitation of all the reservoirs. The work has now been started in the D.V.C. reservoirs.

(Central Inland Fisheries Research Station, Barrackpore).

(iii) Weed Control Experiments

Experiments were conducted to see whether Chinese Carp will successfully eradicate the common submerged weeds in fish ponds. It was observed that Chinese Grass Carp at the rate of 40 to 150 per acre, depending on the density of weeds could successfully eradicate the common submerged weeds *Hydrilla* in the course of a month.

The work of eradication of aquatic weeds by the use of free ammonia was undertaken on a large scale in a number of large ponds in Orissa during the period July–September 1960. It has now been observed that this is a very successful method of eradicating the acquatic weeds and that it is also an economically cheap method. Ammonia, which was reported to be very effective against submerged weeds, has been found to be lethal also to emergent and floating weeds. This new finding enhances the value of the chemical and makes it more economical to work as a combined Weedicide, fertilizer and a lethal agent for unwanted species of fish and prawns.

(Central Inland Fisheries Research Station, Barrackpore)

(iv) Central Fisheries Extension Programme

With the establishment of an additional unit at Raipur in Madhya Pradesh, there are at present, ten Fisheries Extension Units functioning in various States. The programme of these Units has been reorientated laying greater emphasis on the training of village level workers and field staff of State Fisheries Departments. The Units organised two regional subject matter refresher training courses for fisheries personnel engaged in Community Development and National Extension Blocks. Technical assistance was afforded to a number of States in conducting induced breeding of Major Carps. Demonstrations and advice on the application of new and improved fish cultural techniques were arranged in a large number of centres. The information programmes including audio-visual demonstrations were intensified.

FISHERIES DEVELOPMENT IN THE STATES

(i) Fishery Development Schemes in Orissa in 1959-60

In Orissa under the G.M.F. programme there are two schemes of fisheries development viz. (1) Development of fish seed centres, and (2) Village reclamation service.

Estalishment of 40 fish seed centres covering an area of 3 acres each @ 10 each year during the 1st four years of the Plan period has been completed. 73·73 lakhs of fingerlings have been distributed among the Gram-Panchayats and other Pisciculturists by the end of 1959-60 against the Plan target of 50 lakhs. The increase over target has been possible on account of improved piscicultural methods adopted from scheme of Applied Research in Fresh Water Biology.

It was proposed originally to establish 8 reclamation units during the Second Plan period with necessary technical staff and fishing equipment to assist Gram Panchayats and Pisciculturists. In view of the necessity to establish one unit in each district, modified reclamation units totalling 13 have gone into operation since 1960. These units survey, advice on reclamations, supply equipment and also net out and market fish from tanks of pisciculturists. More than 3000 tanks have been surveyed and fishing was done in 694 acres.

Two fisheries Pilot projects (Production) taken up during 1959-60 at Digapahandinand Barpali Blocks have been completed and are being stocked with fish fry with the aim for optimum production and finding out the possible productivity per acre of water area.

Two Extension Seminars were conducted at Sambalpur and Berhampur, Baripada and Jeypore and 24 village level workers and departmental staff were trained in pisciculture with a view to extending the modern fisheries technique among the pisciculturists at village level.

[Development (Fish) Department, Government of Orissa.]

(ii) Annual Report of the Madras Fisheries Department for the year 1958-59

The Fisheries Department after 5 years' of amalgamation with the Department of Industries and Commerce was separated and constituted as a separate Fisheries Department with effect from 1st April, 1958 under a Technical Director.

The State Fisheries Research Council held at Madras on 28th February, 1959, reviewed the work done at the Research Stations and suggested further lines of work. A detailed hydrobiological survey of all the Indian Pearl Banks and chank beds in the Central division of the Gulf of Mannar was undertaken by the team of Scientists headed by Dr. F. B. Salvadori, F.A.O. underwater Exploration expert. A new Pearl Bank off Manapad has been located. The inspection of pearl banks and estimation of the pearl oyster population resulted in a successful fishery. Studies on the biology, ecology, migration of fishes, estimation of population based on the statistics of chanks landed at Tuticorin, ecology of chank beds, spawning and breeding habits and development of chanks, quality of salt used by the fish curing industry and effect of condiments like turmeric with salt used for fish preservation were continued at the Marine Biological Station, Tuticorin. Planktology, trend of commercial fisheries in the Rameswaram Island, analysis of the off shore Fish landings made by the Unit at Pamban, pearl oyster farming, chank farming and

chank marking were continued at the Marine Biological Station, Krusadai. Studies on Meteorology, hydrography, planktology of the Ennore estuary were completed during the year at the Research Station at Ennore. The programmes chalked out by the Research Council for the Fresh Water Research Station at Bhavanisagar and technological and biological Stations at Kanyakumari, Tuticorin and Krusadai were completed.

The State availed of the services of two FAO Experts. Dr. F. B. Salvadori of Italy, undertook exploratory investigations of the pearl and chank beds off Tuticorin for the accurate assessment of these shell fishes and of the environmental conditions of the beds and to train local personnel in the use of Aqua lung and other modern diving equipment. Dr. Garlos Gonzalez of Argentina, Fish Marketing Expert was on assignment in the State between July—September, 1958. The recommendations made by the Expert are under consideration. Two Officers were sent overseas for training in the construction and handling of gear and in the field of boat building and mechanisation of boat.

The 15 Schemes included in the Second Five Year Plan were implemented satisfactorily. The total Plan provision for the year was Rs. 23·44 lakhs and actual expenditure was Rs. 19·07 lakhs. During the year, a sum of Rs. 6,60,928 was disbursed among 74 Societies as loan and subsidy benefiting 3204 members. A total quantity of 6,226 tons of cured fish was produced as against 5201·41 tons in 1957-58. Twenty-three boats constructed were distributed among the Fishermen Cooperative Societies and their Federations. 131 webbings and 605 lbs of Terylene yarn were distributed to the fishermen and these nets have considerably increased their catches. The training imparted at the training centres at Nagapattinam and Tuticorin, provided suitable practical training to the fishermen. Several Municipalities, the Mettur Township Committee and a private market in the city were given subsidies for the improvement of fish markets to the extent of Rs. 0·91 lakhs as against the Plan provision of Rs. 0·77 lakhs. Under the scheme for quick transport of fish from landing centres to the consuming centres, 8 vehicles operated and enabled fishermen Cooperatives to transport fish. Under the scheme for development of fishing harbours, as against the Plan provision of Rs. 3·89 lakhs, the actual expenditure was only Rs. 0·17 lakhs.

There were two pearl fishery, one commenced in 1957-58 and continued till 26th May, 1958 and other from 12th February, 1959 to 16th May, 1959. During the former fishery 2,14,76,514 oysters were fished in 55 days fetching a revenue of Rs. 4,65,097. In the later, a total quantity of 1,64,96,246 oysters were fished in 62 days realising a revenue of Rs. 8,00,568. The chank fishery of Tirunelveli Coast, Thanjavore and Kanyakumari were operated departmentally and 11,55,644, 44,981 and 2702 full sized chanks were fished respectively. The Ramanathapuram and Sivaganga chank fisheries were leased out and the lessees obtained 5,30,385 and 66,831 full sized chanks. One more Fisheries Demonstration Factory was sanctioned at Mallupattinam and this also functioned as an extension Unit to the Fisheries Technological Station, Tuticorin. The Ennore Biological Station continued to supply biological specimens realising a total revenue of Rs. 15,589.

The licencing system for the conservation of inland fisheries was continued. The departmental waters fetched a revenue of Rs. 30,224 towards 9,660 licencees, Rs. 42,166 was realised towards sale of fish to the public and the provincialised waters a revenue of Rs. 2,40,707. The Mettur Reservoir was exploited through 191 licenced fishermen and the total landings was 275 tons. The Government have recently ordered a survey of all blocks in the State by a special staff with a view to assess the possibility of intensifying fisheries activities in them.

The total marine fish landings was about 72,730 tons valued at Rs. 610 lakhs and landings of inland fish was estimated at about 40,850 tons valued at Rs. 245 lakhs. Thirty thousand and thirty tons of fresh sea fish, 22,625 tons of cured fish and 40,368 tons of inland fish were consumed in the State. The per capita consumption of fish in this State during the year was estimated at 11.4 lbs. A total quantity of 14,415 tons of fresh fish and 2,383 tons of cured fish were received in the Madras City and were sold in 47 markets. The per capita consumption of fish in the city is estimated to be about 30.5 lbs per annum. The Fishermen Cooperative Marketing Society at Mettur Dam continued to undertake marketing with the assistance of the Department.

The compilation of marine and inland fisheries census of fishing population and their craft and tackle were continued. The fresh water aquarium on the marina was visited by 1,00,559 persons.

The total number of Cooperative Societies and Federations at the end of the year was 206 and 6 respectively with a total membership of 24,920 and paid up share capital of Rs. 2,08,324. These Federations and Societies were given long term and short term loans and subsides for purchasing gear and other fishery requisities. Several relief measures and assistance were given to the fishermen. The Department continued to maintain Adult Literacy Night Schools, the 3 Elementary Schools at Sathankuppam, Alambariakuppam and Kaviripatnam.

The total expenditure of the Department for the year was Rs. 36,61,435 and total receipt was Rs. 28,17,014.

(iii) Fishculture Schemes in Uttar Pradesh

In Uttar Pradesh, 3,96,31,250 fry and 5,36,325 fingerlings were collected from natural spawning grounds and 3,21,000 fry were raised by induced breeding through hormone injections during the period July to September, 1960. To enhance fish production 1,02,300 fingerlings were stocked in departmental waters while 1,16,500 fingerlings were supplied to the private pisciculturists for stocking private owned waters. Two nursery ponds were also acquired for rearing fry.

(Deputy Director of Fisheries, U.P.)

MARINE FISHERIES RESEARCH

Annual Scientific Report of the Central Marine Fisheries Research Station, Mandapam for the year 1959-60

Progress in the various research programmes of the Station was maintained during 1959-60. Systematic studies and collection of data on the economically important fishes were continued at all the important fishery Centres. A Research/Survey Centre was established at Cannanore and a preliminary study was made of the fishery resources of the Andaman and Nicobar area with a view to setting up a Research Unit in the Island.

Fishery Survey :

The analysis of data collected in 1959 was completed and the total landings of marine fish during 1959 was estimated as 584,193 m. tons as compared to 755,774 m. tons in 1958, showing a decrease of about more than 0·17 million tons. This was mainly due to the failure of Mackerel and Oil Sardine fisheries. Other fisheries excepting those of Flying fish, *Thrissocles*, other clupeids and Polynemids also showed significant decrease. The total effort in 1000 man hours was 247,379 catch in kg., and per man-hour was 2·34 during 1959. The Survey

Programme has introduced a slight change in the methods of collection of fish landings in Kerala, Mysore and in Bombay. Under this new Scheme, instead of collecting data at fixed centres, the selection of landing centres were made at random.

Fishery Biology :

Inshore fisheries investigations on the major shoaling fisheries of Oil sardine, other clupedis and Mackerel were continued at Karwar, Mangalore, Kozhikode, Ernakulam, Neendakara, Mandapam, Waltair, Vizhingam and at Porto Novo. Observations were made on the trend of the fishery during the different months, total annual catch at important fishing centres, gear employed, length—frenquency, size and year class, compositin of fishery, food and feeding habits. growth, maturity, fecundity, sex-ratio and percentage distribution.

The Oil sardine fishery at Kozhikode was in general supported by three different year classes, the modal sizes of which were around 100,140 and 175 m.m A notable feature was the occurence of denser shoals within the 10 fathom area, mostly 4-8 fathom region during the peak season. From the general decline of the Oil Sardine fishery from 1957-58 to 1958-59 it has been inferred that the level of annual recruitment during the past two years had been very low.

At Karwar since the last decade for the first time the Mackerel fishing season extended for about seven months. The fishery during 1959-60 was, however, a total failure all along the North Kanara coast. Studies on Mackerel reveals that there was no mixing up of populations nor of different age groups appearing in the same shoal. In connection with the racial investigations of Mackerel, comparative studies with *Rastrelliger* species from other regions of the Indo-Pacific have been completed. These studies showed that the Indian Mackerel is characterised by six posterior finlets and the total number of dorsal fin rays number 29.

Prawns and lobsters investigations were carried out at Bombay, Mangalore, Kozhikode, Ernakulam and Madras. Routine collection of data of this fishery were continued in regard to growth, maturation and breeding. These studies revealed that months of October and November are noteworthy because of the intensive breeding activity of most of these species; none of the penaeids seem to spawn in inshore areas. A comparative study of the inshore prawn fishery based on the Dol net catches along the Bombay coast was initiated. Studies on the prawn fishery at Alleppy, Chellanam and Narrakkal as part of the programme of population and recruitment studies have been carried out at the Prawn Research Unit at Ernakulam. Review of the fishery at Alleppey during 1956 to 1960 showed that the fishery has been steadily declining. A close study of the prawn catches of two Government of India trawlers and two INP vessels has been started to study the distribution of penaeid prawns of Kerala coast. Investigations on the biology and fishery of *Palaemon carcinus* was initiated. Study of the rich prawn fishery of the Pulicat lake was taken up at Madras.

Biological investigations on the fisheries of Malabar sole, Half beaks, Seer fish, Mullets and Tunnies were continued. It has been possible to collect and identity the early larvae of *Katsuwonus pelamis* and *Neothunnus macropterus* from the Laccadive area. Tuna was found to migrate for food towards the coral reefs thus contributing to a rich fishing in the Laccadive Sea.

Molluscan Research Unit in collaboration with the scientific staff of the Madras State Fisheries Department and under the direction of the F.A.O. Under-water Expert carried out a detailed survey of a few Oyster Paars off Tuticorin and the data collected was analysed. The study on the seasonal gonadial variation of the adult pearl Oysters was started during the year.

Offshore Fisheries Investigations

Offshore fisheries investigations were continued at Bombay, Ernakulam, Tuticorin and Waltair and the Units were engaged in collecting and analysing the data of fish catches of New India Fisheries Trawlers and the Government of India vessels, with regard to intensity of fishing, seasonal variations, catch-per-Unit-of effort, composition of fish catches in different fishing grounds.

A salient feature of the otter trawling operations was the consistent good catches of Dhoma forming about 50·7%. The peak periods of abundance of fish were from April to May and October to February.

Investigations on the fishery and biology of commercially important species of the trawler catches of Dara, Ghol, Koth, Karkara, Wam and Bombil led to a large number of interesting findings. Maturity and ova diameter studies indicated the presence of only one spawning in a year in Ghol (*Pseudosciaena diacanthus*), Koth (*Otolithoides brunneus*) Karkara (*Pomadasys hasta*) and Wam. The study of scales and otoliths were continued in connection with age and growth of the different species. Raciation studies of *Harpodon* from different places on east and west coast showed that the populations of the different centres did not come from a single homogenous stock.

Two tuna fishing voyages were undertaken, by the Research Vessel 'Kalava' and the purse-seiner 'Bangada'.

Shrimp trawling operations by the vessels of Offshore Fishing Station, Cochin gave an average catch of 208 kg. per hour while it was 151 kg. per hour for INP vessels. The catch returns were found to be distinctly higher in the post-monsoon months than in the pre-monsoon months. Fishery biology studies of *Nemipterus japonicus* occurring abundantly in the trawl catches were taken up.

At Calcutta catch analysis of the West Bengal trawlers were made. 26 voyages were performed by these trawlers with a total catch of 2,37,719 kg. Information on catch, area of operation, depth range etc. were gathered. Black Pagoda off the Mahanadi appears to be the most productive fishing ground and each of the areas was dominated by different groups of fishes. Fish landings was found to be highest during winter season. Sciaenids formed the most important catch constituting 63% of the total with a peak period in January.

Experimental work on Marine Fish Farm at Mandapam yielded 195 to 455 kg. per hectare and the results indicated the need for artificial enrichment of the ponds for optimum production. Further investigations were continued.

Marine Biology :

Planktological investigations continued at Kandla, Karwar, Mangalore, Kozhikode, Mandapam and Madras. At Kozhikode investigations on the possible relation between polychaetes and bottom fisheries with special reference to *Cynoglossus* fishery and estimation of the organic production in the sea by the dark and clear' bottle method was started. Studies in organic production from 6 stations in the Gulf of Mannar and Plankton of the inshore waters were continued at Mandapam.

Oceanographical studies were continued at Bombay, Karwar, Mangalore, Kozhikode and Ernakulam, the last also covered the offshore waters and the Laccadive Islands. At Bombay an attempt was made with some success to evolve a simple field method for phosphate 'surveys'.

Algology :

Taxonomic study of the Algae collected from the pearl beds off Tuticorin was completed. One new genus of Lophothaliea was recorded and critically studied. Work on the agar manufacture and resources was continued. A new method of obtaining colourless agar from *Gelidium* and *Gracilaria* was found. An estimate made of the collection of sea weed from Pamban and adjoining islands indicated a production of 2·6 m. tons of refined agar.

38 Scientific papers were published during the year from the Research Station.

(Central Marine Fisheries Research Station, Mandapam)

INLAND FISHERIES RESEARCH

Annual Scientific Report of the Central Inland Fisheries Research Station, Barrackpore for the year 1959-60

The Headquarters of the Research Station was shifted to its newly constructed buildings at Barrackpore with effect from 18th June, 1959.

The 12th Session of the Inland Fisheries Training Course conducted during the year was attended by 36 candidates including 2 Colombo Plan trainees.

Pond Culture Division :

Both at Cuttack and Joysagar breeding was successfully induced in Catla, Rohu, Mrigal and Calbasu. Commercial production of large number of spawn and fry was achieved for the first time by this method. Best results were obtained from breeding experiments conducted in running river water. Now specificity of the pituitary glands to induced spawning also could be clearly demonstrated.

Intensive breeding of *Cyprinus carpio* was taken up and over 10 million fry, valued at about Rs. 4020 were supplied to the State Fisheries Department. Breeding was also conducted in cement cisterns containing tap and well water. Mirror carps could be made to breed at Cuttack and Josagar.

Silver carp fingerlings received as gift from Japan and grass carp fry imported from Hong Kong are being used for investigations to find out their suitability for culture under Indian conditions.

Attempts to maintain a large size of marketable crop of *Tilapia* were sucessful and it could be demonstrated that presence of this fish affects the growth and survival of mrigal. Observations on monosex culture of *Tilapia* and use of the fish as forage fish for murrel have also been made.

A random survey to study the soil conditions and water qualities of fish ponds in different parts of the country has been started. Experiments to study the effect of trace elements when applied with organic fertilisers and to determine whether low nutrient acid soil could be corrected by application of organic and inorganic fertilisers with lime, were in progress.

Significant results were obtained in weed control investigations also. Field experiments indicated that *Hydrilla* and unwanted fish are completely eliminated by 250 and 330 p.p.m. of Urea. A new method of controlling submerged vegetation by means of anhydrous Ammonia has given very encouraging results. It was found that Sodium meta-bi-sulphate at 75 p.p.m. mixed with an equivalent quantity of sulphuric acid kills *Hydrilla* completely.

Riverine and Lacustrine Division :

The catch statistics and disposition of fisheries in the Ganga River System, Narbada River and Godavari river were studied regularly throughout the year. Detailed data on monthly production and average catch per day have been collected and studied.

Biological studies were conducted on the more important species of fish like *Mystus aor, M. seenghala, Catla catla, Silonia silondia* and *Rita pavimentata.*

Spawning grounds of *Hilsa ilisha* in the Narbada river were located between Piocha and Indravana.

Physico-chemical and biological factors affecting the distribution of Ganga fisheries were studied regularly.

Stream pollution studies indicated that none of the chemical conditions observed in the Ganga were sufficient to cause mortality of fish. Blooms of *Mougeotia* and *Fragillaria* were found to have had no relation to pollution. Lethal limits of tolerance shown by *Mystus vittatus* and *Puntius sophore* were studied with reference to textile and tannery wastes. Mortality of fish in the Dalia was found to be entirely due to deoxygenation. Bio-assay experiments were conducted using *Puntius sophore* as test animal.

Lacustrine Investigations :

Studies on fisheries at Tungabhadra Dam were continued and the total weight, size range and mean size of twelve predominent species of fish were calculated. Departmental fishing was undertaken in the reservoir and it was noticed that Uduvalai nets yield more catches than Rangoon nets. A survey of the nets and tackle used in the area was also completed. Plankton, physico-chemical conditions of water and soil and bottom fauna were studied regularly. A direct relationship between production values and concentration of phytoplankton has been observed. A rapid survey of the fisheries of the Collair lake and fisheries and physcio-chemical conditions in Krishnaraja Sagar were also conducted.

Estuarine Division :

The programme of investigations on the fisheries of Hooghly, Matlah and Mahanadi estuaries were continued. The year under report envisaged the commencement of the second phase of this programme and 26 species of fishes and 5 of prawns were used for intensive studies on population dynamics. A pilot survey was conducted in Zone II of the Hooghly in order to estimate the sampling error and assess the suitability of the design followed for the collection of catch statistics. Interpenetrating sampling technique was adopted in six selected fishery villages. There was a marked increase in total landings of fish in the Hooghly and Matlah estuaries. The total catch and catch-per-unit-of-effort in the estuaries were estimated by a combination of sampling survey and total enumeration methods. Analysis of commercial catches were made regularly and the percentage composition of all important species were studied.

Hydrobiological and plankton studies of the estuaries were continued. The general decline observed in the production of both zoo and phytoplankton during the previous year continued except for occasional spurts of increase at a few isolated centres.

The field work connected with the studies on the productive potential of brackish water bheries was concluded and the brackish water fish culture unit moved to Cuttack where experimental work is being conducted at the Kirgachimadli fish farm of the Orissa Fisheries Department. Studies on the distribution and abundance of eggs, larvae and young fish in Hooghly, Matlah and Mahanadi were initiated.

Investigations on the Hilsa fisheries:

Studies on the population structure of Hilsa in the major river systems and their racial charcteristics, the composition of chemical catches, biological characteristics of the Hilsa stocks and large scale tagging of Hilsa were the more important programmes taken up during the year. Environmental studies indicated that turbidity and the quantity of plankton play an important part in the establishment of the Hilsa fishery in the lower Sunderbans. The total catch for the year in the area covered by the Hooghly, Rupnarain and Matlah river systems, including lower Sunderbans, was about 139 Metric tons. The total number of Hilsa tagged during the year were 578 of which 54 have been recovered in good condition. There appear to be great variations in the speed of movement of Hilsa and the shoals appear to show a certain amount of dispersal in the area covered.

Exploratory fishing:

Preliminary bottom contour surveys and exploratory fishing with the research vessel M. V. "Sunderbans", were conducted from December, 1959 onwards. Extensive operations have been carried out in the Muriganga, Saptamukhi and lower Matlah regions.

Chilka lake Investigations:

The execution of a large-scale tagging operation on six most commercially important species of fish was successfully conducted and 6714 specimens were tagged during the year. The overall percentage of recovery was 6·63%. The survey of the commercial fisheries was continued and it was estimated that about 37,96,767 kgms. of fish were captured during the year ending December, 1959. Detailed data on the species composition have been collected. Biological studies were conducted on *Mugil cephalus, Penaeus indicus. Eleutheronema tetradactylum, Sparus sarba, Lates calcarifer, Gerras setifer, Pseudosciaena coibor, Mystus gulio, Osteogeniosus militaris. Plotosus canius* and *Tachysurus arius.* Regular observations on the physico-chemical features of the Chilka lake were continued.

Fish Pathology Investigations:

Experiments on fish mortality in jute retting tanks were continued. A new type of eye disease causing mortality of *Catla catla* was investigated in detail and about Rs. 35,000 worth of fish were saved by applying group treatment in 5 tanks. Studies were conducted on "Exopthalmus", "Dropsy", Tumour disease of Gold fish and Ligula infections in Tilaya reservoir.

Publications:

Twelve scientific papers were published from the Research Station during 1959-60.

(Central Inland Fisheries Research Station, Barrackpore).

FISHERIES TECHNOLOGICAL RESEARCH

Central Fisheries Technological Research Station, Ernakulam—Report for the Quarter Ending 30-9-60.

At the Processing Wing of the Central Fisheries Technological Research Station, at Ernakulam, the studies on the variation of trimethylamine oxide content of backwater prawns were continued. Progress was made in the study of spoilage of prawns at O.C. and its assessment by objective tests. Investigations were continued on the development of several chemical compounds which are useful as indices of spoilage in prawns kept at the temperature of melting ice. The duration of storage at this temperature before deleterious biochemical changes occurred and the range of values of the different indices at the border line stages were determined. Distinct differences in the keeping quality were observed in whole, headless, and peeled prawns held under similar storage conditions.

Studies on the rate of multiplication of bacteria in cooked prawns at different temperatures is in progress. Cooked prawns from the factories as well as from batches prepared in the laboratory were kept in sterile containers, incubated at 55°, 40° and 30°C respectively and sampled for total bacterial count at definite intervals. Samples from the same batches were also kept exposed to the atmosphere at identical temperatures to study the extent of external contamination. It appears that external contamination is definitely more than the multiplication of inherent bacteria of the cooked prawn during storage for 3 to 4 hours.

Experiments on pickled shark flesh and flying fish were continued. After a storage life of about a month, the flying fish was found to be heavily infested with "red attack". This was true in the case of tamarind treated fish also. Pickled shark flesh which showed red halophile growth were treated with propionic acid and transferred to fresh brine for observing protective action by the preservative.

Brine salted mackerels from the curing section and brine were taken for bacterial analysis. The colonies were mainly moulds. A few red halophilic coccii 10-15 colonies per gram were present.

The temperature controlled boxes designed to work at 0°C, 1·5°C and 3·5°C were readjusted and conditioned for work. Another box with constant temperature of 17°C for incubating the plates inoculated with organisms isolated at low temperatures was designed and tested.

In the Craft Design Section of the Craft and Gear Wing, the designs of 75′ and 100′ trawlers were completed. Redesigning of the conventional round bilge 32′ shrimp trawler on the chesi form has been taken up. Stability calculations for a 49 ft. wooden side trawler and also the stability properties of a 36′ shrimp trawler were worked out using an Integrator received on loan from F.A.O., Rome. Drawings of a 38′ vessel for Laccadive Administration was prepared. The design of a 14′ outboard motor boat for the Processing Wing of the C.F.T.R.S. was finalised.

Trials with vegetable oils like 'Poon' and Cashew shell oil, fish oil etc. coated on wooden panels were continued and the results prove that the oils retard borer and fouler attacks to a certain extent. Further work is in progress. Tests with "Indal" aluminium alloy indicate that aluminium alloy is suitable as a sheathing material. Wooden panels treated with anti-fouling red paint

and pebra wood bone (black) and subjected to immersion tests indicate that timbers like "Ajili", Mango and Venteak are free from attack of borers excepting traces of barnacle settlement.

The statistical analysis of data on characteristics of hand twisted cotton twines used for gill nets was completed. Hand twised sun hemp twine used for fabrication of different types of nets are being studied. The experiment started to assess the optimum concentration of the extract of bark of *Acacia arabica* by fixation method was completed. Observations on the studies to find out the utility of cow dung, rice water, ragi flour on cotton with coal tar treatment are being continued. The fourth series of experiments to evaluate the effectiveness of tannin extracts from *Acacia arabica*, Panachika and *Terminalia comentosa* plus coal tar both by the fixation and non-fixation methods were completed.

The work on the fabrication of 40′ two seaming trawl net of 2·5 to 1″ mesh and 19′ sailing trawl of 1″ mesh was completed. Work on 65′ Norweigian type trawl and 55′ four seaming trawl is in progress. Two series of experiments on characteristics of 32′ two seaming trawl net, one with otter boards of 40″ x 20″ and other with 35″ x 17·5″ dimensions were completed.

Catch data from different fishing agencies were analysed to work out the catch-per-hour of trawling, catch-per-hour for different head rope lengths and catch per hour with engines of different mechanised fishing crafts engaged in otter trawl fishing, details regarding consumption of oil, salary of crew etc. are being collected.

The practical boat building course for carpenters from different States is in progress.

(Central Fisheries Technological Research Station, Ernakulam).

(i) Quality of prawn handled in factories

Prawns start spoiling soon after they die. The digestive juice continues to be active even after death and the bacteria from the intestines and slime start multiplying. The most effective method to prevent such spoilage is to bring down the temperature of the material by icing or freezing. Icing is the most practical means of preservation when the material has to be transported from place to place *e.g.* from the landing place to the peeling site and from there to the factory. The low temperature provided by the ice will keep down rapid growth of the bacteria in the fish or prawn, which grows best at temperatures between 87° and 104°F.

The freshness of the raw material is very important from the point of view of the quality of the finished product. The prawn processing factories in our country receive their supply of raw material in the form of whole, peeled and deveined or headless prawn from places often far away from the factory. This involves long distance transport of the raw material. Under such circumstances if the material is not properly cooled, spoilage will go on unhindered.

Use of sufficient ice in the proper manner is the only means to effectively overcome spoilage in prawns. Allowance has to be made for the melting of ice due to atmospheric contact, drainage and the cooling of the containers when the quantity of ice is calculated. On an average, one pound of ice to a pound of prawn would be sufficient. It is also advisable to use the ice intermittently between thin layers of prawn, so that the cooling may become rapid, effective and uniform.

(Central Fisheries Technological Research Station, Ernakulam).

(ii) Thermotranquilization for Export of Live Lobsters Abroad

Live lobsters for export to foreign countries by air shipment should be in healthy and active conditions before they are subject to the effects of thermo-tranquilization. They are then introduced in a tank containing natural sea water of which the temperature is brought down to 10°C by cooling it with ice around the tank or by putting ice enclosed in plastic bags immersed in this sea water.

Keeping the lobsters in this cold water for about one hour is enough to cause tranquilization that will retain its beneficial effect for a period of at least 15 hours of air flight so far observed.

Card-board cartons are considered the cheapest containers for packing live lobsters. A suitable packing material is provided by wood shavings soaked in sea water. Normally 350 gms. of soaked wood shavings are sufficient for six good size lobsters.

(Director of Fisheries, Maharashtra State, Bombay).

(iii) Pre-process Preservation of Raw Material in the Factories.

Extreme care is required in handling prawns from the time of catch through the peeling stage and transportation. The temperature of the material has to be maintained at 32°F during this period to avoid any possible loss of quality The cheapest and most effective method to do this is to keep the material in adequate quantities of ice from the very beginning until it arives in the factories. This appears to be the only means by which the factories can be assured of the supply of quality raw material, under the existing system of supplyand distribution.

In the factories too it is equally important to keep the material cooled to ice temperature until it is finally frozen. The usual practice is to wash the material in tap water and to keep it in chill storage with ice and water. But the interval between the arrival at the factory and storage in the chill room is sometimes long so that the temperature of the material is liable to go up. This has to be prevented at any cost by using more ice at this stage to ensure the maintenance of the quality.

A series of experiments were carried out to study the cooling rate of material at different initial temperatures, when kept in chill storage. The results are as follows:—

Rate of Cooling of Raw Material in Chill Storage.

Temperature of raw material °F	Difference between raw material temp. and chill storage temp. °F.	Time taken for cooling to 47°F	
		Hours	Minutes.
94	47	13	20
80	33	13	09
75	28	12	45
70	23	12	15
65	18	11	35
60	13	10	00
55	8	7	30
50	3	3	45

It may be seen from the above that a material having an initial temp. of 94°F takes about 14 hours to cool through 47°F, while another at 60°F takes about 10 hours to cool through 13°F and a third one at 50°F takes about 4 hours to cool through 3°F. Even in spite of chill storage normal bacterial growth can continue in these raw materials until they cool down to the vicinity of 32°F. It is, therefore, evident, that in order to make chill storage preservation of the material really effective and useful it has to be precooled with ice before keeping in the storage.

(Central Fisheries Technological Research Station, Ernakulam)

(iv) **The common characteristics of cotton fishing net twines—A preliminary account.**

The common fibres used in India as fishing net twines are cotton (Gossipium spp.,) and sun-hemp (Crotalaria juncea) both of which are produced in the country. Cotton is by far the most important fishing gear material all over the world. In this communication an account of the characteristics of cotton twines, subjected to the preliminary tests, are presented. The essential basic characteristics of soft twisted cotton fishing net twines are shown. The inter-relationship between the mass, the diameter, the number of threads, the breaking strength, breaking stretch and the effect of reef and trawl knots have been discussed.

(Kuriyan, G. K. and (Miss) Cecily, P. J., Indian Jour. of Fisheries Vol. VI, No. 2 October, 1959).

(v) **Preliminary Studies on the characteristics of Coir Twines**

Coir in the form of twines and ropes is a fishing gear material widely used for the fabrication of essential components of several types of fishing implements. Five different grades of coir twines, (i) Superior Anjengo, (ii) Ordinary Anjengo, (iii) Real Alapat, (iv) Imitation Alapat and (v) Special Mangaden, were studied with reference to the weight per metre, number of twists and breaking strength and breaking stretch (in dry and wet condition).

The weight of twine per square mm. diameter of the various twines do not fluctuate widely except for Real Alapat variety, unlike other fibres of vegetable, origin, the coir twines loses breaking strength by 5–24% in the wet condition. Alapat variety is stronger than Anjengo, Real Alapat variety stronger than Imitation Alapat and Superior Anjengo stronger than Ordinary Anjengo and Special Mangaden stronger than Ordinary and Superior Anjengo.

The breaking strength of coir twines in dry and wet condition is lower than that of Sunhemp twine.

(Gopalan Nayar, S., Indian Jour. Fisheries Vol. VI, No. 2. October 1959).

FOREIGN

GENERAL AND DEVELOPMENT

MARINE

Information on Arctic Fish Stock

In recent years, both commercial and sports fishing enterprises have been established in the Canadian north. The Research Boards of Canada's Arctic Unit based on Montreal, has made a survey of fish stocks of Mackinzine and Kecwatin Districts. This survey covered some 21 lakes extending east from Great Bear Lake to the north-west coast of Hudson Bay. The lakes were carefully selected to represent many water sheds including those drained by the Coppermine, Back, Thelon and Dubawnt rivers.

White-fish and lake trout were dominant species in all water area studied, followed by round whitefish, pike, cisco and grayling. The distribution of Arctic Char was limited to waters draining directly into the Arctic Ocean.

The Research Board, the Institute of Fisheries of the University of British Columbia and the Division of Fishes of the Royal Ontario Museum are now identifying the fish taken during the Survey.

In addition to information gathered on the fish of the area, the biologists collected a variety of associated material for other organisations and specialists in the many different fields of biology.

(Trade News Jan. 1960).

INLAND

The Freshwater Fisheries of Manitoba

Manitoba's water area is approximately 39,000 square miles of which about 22,000 sq. miles are fished commercially. There are between 5,000 and 6,000 fishermen who land about 30 million pounds annually valued at five to seven million dollars. The most prolific fishing grounds are Lakes Winnipeg, Winnipegosis and Manitoba, which have a combined area of more than 13,000 sq. miles. These lakes account for more than four-fifths of the catch. Besides these there are 90 small lakes and rivers where commercial fishing operations are carried on.

The number of boats and fishermen have steadily increased. At present there are some 14 vessels and about 2,200 fishing boats and 1,00,000 gill nets are used in the fishery. In the winter gill nets are set under the ice through holes cut manually with a special chisel or needle bar or with a power auger.

From 1955 a separate Fisheries Branch under the Department of Mines and Natural Resources administers fishing regulations. This branch exercise control over fishing seasons and areas, specify types and size of gear to be used and control the members of fishermen by a convenient license system. Fish inspection at processing plant and survey of commercial lakes are also made to determine the quality of the fish for market. The Fisheries Branch has also developed sport fishing. More than 1,00,000 angling licenses have been issued. The department has also taken up the programme of stocking and management of lakes and streams.

(J. E. Steen—Trade News. September, 1959. p. 8-10).

TECHNOLOGY

(i) Anodes Stop Crabs Pot Corrosion

The Chesapeake Bay, Virginia (U.S.A.) crab fishermen were faced with a problem. Their galvanised wire crate pots were serviceable for only 6 to 8 weeks before salt water corrosion caused the wire strands to crumble and the pots became completely useless. By using a sacrificial anode on the same principle as for steel hull protection systems, it was found that pots could stand up to a complete seasons wear (6 months or more) before they needed replacement. The results of the experiments of size and shape of the anode and the position and mode of attachment are expected but preliminary examination of the problem has confirmed that zinc crab pot anodes are a simpler and cheaper solution than the substitution of Monel, stainless steel, aluminium or plastic for the galvanised wire of current crab pots. The anode is normally fitted on the inside of the pot about 4 inches above the base by weaving the cast iron galvanised wire through the screen and crimping the ends tightly about the heavy structural wire reinforcing the seams of the pot.

The anode functions properly if a right connection is made to the pot. They are now in volume production.

(World Fishing September 1959 Vol. 8. No. 9.—page 67).

(ii) **A mechanical fish loader:**

This mechanical fish loader is mounted on a two-wheel trailer that can be towed by a small tractor or pick up truck. Powered by a 6-horse power gasoline motor and heavy duty winch with a 24-inch drum the load-ling arm or boom is on an invested truck hub and can be pivoted to any position. The boom is telescoped so that its reach can be adjusted. The cable that lifts the basket is threaded through the pipe with pulleys at each end.

The basket-steel-reinforced, perforated aluminium—has a trap bottom that is operated by a spring catch for quick opening and closing. It holds 200 pounds of fish.

Scales attached to the basket lifting cable are set at zero, with the weight of the basket and protected by a chain yoke and boomer. The weight of the fish can be read quickly by releasing the boomer on the protective yoke.

(The progressive Fish Culturist—Vol. 22, No. 1, Jan. '60 pp. 33).

(iii) **Nutrition: New Fish-Flour Plant.**

The first full-scale commercial plant for the production of edible fish-flour is being built in Sweden and will soon be in operation.

The flour contains 85% animal protein which compares with about 15% protein content of fish and meat when fresh. This is one of the highest concentrated protein substances yet produced by man.

The new flour can be used in making bread, paste, cakes, pastries etc. and can be added to soups and sauces and other food stuffs. Such an addition adds only a fraction to the cost because the edible fish flour is little more expensive than wheat or maize flour. Any type of fish can be used, from sharks to sprats.

The development of this method of manufacturing edible fish flour is of great practical significance for the under-developed countries and it is planned to set-up plants in various parts of the world.

(Rural Health Digest Vol. 2 No. I 1960)

(iv) **Pharmacological Studies on the Melanophores in Fundulus heteroclitus (Killifish)**

Treatment of *Fundulus with* (OMPA) hexemethonium and octamethyl pyrophosphoramide by injection or by immersion renders light specimens dark. The OMPA is probably transformed in the fish into an anticholinesterase product; the resulting accumulation of acetylcholine causes the darkening of the fish. Injection of hexamethonium into a light, *Fundulus* darkens the fish. This is explained on the basis of central nervous depression by the drug, resulting in the blocking of impulses via—the adrenergic pigment-concentrating neurones.

Injection of decamethonium into a dark *Fundulus* renders the fish light. This result cannot be explained in terms of a peripheral block at the junction of the cholinergic pigment—dispersing neurone and the melanophore. The mechanism involved is still not clear. The methonium compounds were not absorbed by fish immersed in them.

(The Progressive Fish Culturist—Vol. 22. No. I Jan. '60)

(i) Trade of Prawn and Prawn Dust to Malaya

Suppliers	Crustacea (Fresh) chilled or frozen		Crustacea (salted) dried or cooked.		Meat meal and prawn dust.	
	Tons.	M$ 000	Tons.	M$ 000	Tons.	M$ 000
United Kingdom	.3	2.9	..	.2	..	..
Hong Kong	.1	.8	..	..	..	..
North Borneo	2.0	3.4	12.7	29.0	11.6	2.7
Australia	3.7	21.9	14.1	48.9	1002.5	268.5
China	.1	.5	40.2	59.1	827.2	298.5
Riouw & Lingga	.1	.2	14.9	32.6	30.2	6.2
Sumatra	56.8	71.3	442.5	913.1	5141.8	1225.5
Thailand	630.0	251.5	..	..	..	..
Pakistan	..	..	0.1	0.1	24.9	8.0
Sarawak	..	..	85.7	233.3	..	..
India	..	..	33.6	72.0	36.6	8.6
U. S. A.	..	..	..	0.2	.2	0.2
Viet Nam	..	..	12.2	26.2	..	..
Java	..	..	6.2	6.1	40.0	9.4
New Zealand	..	..	..	..	310.7	87.3
Cambodia	..	..	..	..	25.0	0.8
	693.5	352.5	662.8	1420.9	7451.1	1915.6

(Commission for India, Singapore)

(ii) Brazil now exports fishery products

Brazil's fishing fleets have increased their catches so greatly that Brazil has now become an exporter of fishery products. In only two years, fishery production of Rio Grande de sur area has increased 1000 per cent. During the first half of 1958, Brazil exported to the United States some 500 metric tons of frozen tuna valued at 3,00,000 dollars. In 1957 Brazil exported $4,00,000 worth of Spiny lobsters to the United States. The Brazilian Government plans to increase exports of Tuna in 1959 to 15.000 tons valued at 9 million dollars.

The fishermen are being instructed in the use of modern fishing equipment by Japanese technicians from different companies operating in Brazil. The agreement signed between the companies and Government stipulate that subordinate officers and 2/3 of the crew of the fishing vessels must be Brazilian.

(Fisheries Newsletter—November, 1959—page 17)

(i) A study of measures of population density and of concentration of fishing effort in the fishery for yellowfin tuna, *Neothunnus macropterus*, in the Eastern Tropical Pacific Ocean from 1951 to 1956.

This study shows how the catch and effort statistics, from 1951 to 1956, of the fishery for yellowfin tuna *Neothunnus macropterus* in the Eastern Tropical Pacific Ocean have been used to compute: (i) two indices of average population density; (ii) an index of concentration of effort on areas of greatest density of available yellowfin. These indices were then used to determine (i) quarterly and annual variation in each of them; (ii) the relationship between the two indices of density; (iii) the relationship of each of the indices to the number of exploited one-degree rectangles. To remove extreme sampling variations at low levels of effort, the data from all one-degree rectangles subjected to less than five logged days fishing in a quarter were eliminated, and the computations were repeated for comparison with those of the original data.

The index of density, unweighted by the area of the fishery, is more variable than the index so weighted, before and after elimination of data from one degree rectangles with low fishing effort. Nevertheless, both indices had relatively high values in 1951, which declined to a low level in 1953 and subsequently increased to a second peak in 1955, declining again in 1956. The coefficients of variation (c), using quarterly data are: 0·44 (BE unweighted). The respective variances of the logarithms (5^2 logs) of the quarterly values of the indices which are another measure of relative variation, are 0·031 (BE) and 0·029 (BE), 0·032 (AE) and 0·027 (AE).

The concentration index is less variable than either index of density. Although this index, like those of density, has high values in 1951 and 1955, there is no obvious decrease in the intervening years. The coefficients of variation are 0·26 (BE) and 0·24 (AE). A new area, the 14 fathom spot was exploited in 1953; 4. .In 1954: 1 it was exceptionally productive of yellowfin which greatly effected the concentration index in that quarter. Consequently, the index was modified by omitting data from south of 5° s in 1954; 1; after this modification the coefficient of variation becomes 0·21 (BE) and 0·18 (AE).

There is a correlation coefficient (r) of $\pm$ 0·75 (BE) and $\pm$ 0·84 (AE) between the two indices of density. This relationship is best described by a straight line. The coefficient of regression (b) of the unweighted index on the weighted index is 1·70 (BE) and 1·27 (AE). The corresponding annual correlation coefficient is 0·98 (BE) and 0·99 (AE), and the annual regression coefficient is 1·67 (BE) and 1·26 (AE). The regression coefficient is the average concentration index for the six year period considered. The confidence limits of b are given in all cases.

One density index can be predicted from the other, but, because it is usually preferable to predict the weighted index from the more easily computed unweighted index, the regression should be of the weighted index on the unweighted. This regression coefficient is 0.62 (BE) and 0·82 (AE), for the quarterly data. The confidence limits, which increase with x, are given by other slopes. Thus the 95 per cent fiducial limits of the mean x value at each x value are defined by the slopes 0:62 $\pm$ 0·07 (BE) and 0:82 $\pm$ 0·82 (AE). The 95 per cent fiducial limits of the individual y values at each x value, are given by the slopes 0·62 $\pm$ 0·33 (BE) and 0·82 0·34 (AE).

The annual regression coefficient for prediction purposes is 0·60 (BE) and 0·80 (AE). The 95 per cent fiducial limits of the mean y value at each x value are given by the slopes 0·60 ± 0·05 (BE) and 0.80 ± 0·05 (AE); the 95 per cent fiducial limits to individual y values at specified x values are given by the slopes 0·60 ± 0·12 (BE) and 0:80 ± 0·12 (AE).

The correlation between the concentration index and the numbers of exploited one-degree rectangles N, is r = −0.0033 (BE) and −0·19 (AE). The point for 1954: 1 is markedly divergent, however, owing to the effect on the concentration index of the newly exploited aggregations of yellowfin south of 5° S, consequently, by omitting these data (from south of 5° S, the correlation is improved: r = −0·31 (BE) and −0·22 (AE). The corresponding annual values also show improvement; though they do not reach the 05 level of significance: r = −0·11 (BE) and −0·20 (AE) and after modification of 1954:1, r = 0·53 (BE) and −0·67 (AE).

The correlation between the weighted index of density and the number of exploited one-degree rectangles is r = −4·44 (BE) and −0·40 (AE). Annual values give correlations of r = 0:94 (BE) and −0:87 (AE).

The correlation between the unweighted index and the number of ex-exploited one-degree rectangles is r −0·50 (BE) and -0·44 (AE), for quarterly values. For the annual values r = −0·94 (BE) and -0·92 (AE).

Elimination of data from one degree rectangles subjected to less than five logged days' fishing per quarter involved eliminating 2 per cent of the catch, 4 per cent of the effort and 48 per cent of the one degree rectangles, on the average. There are, therefore, changes in the numerical value of the indices: on the average, the unweighted index of density is increased 2·5 per cent; the weighted index is increased 35 per cent; and the concentration index is decreased 25 per cent.

The quarter to quarter distributions of catch-per standardized-days' fishing averages by one degree rectangles display the general shifts of the fishery. Although these changes are apparent in the figures, caution is needed in their interpretation. The important fishing areas are:—

First Quarter: Off Central Mexico, Central America; Northern South America and the Revillagigedo Islands.

Second Quarter: As in the first quarter, but with a shift towards the local banks (off lower California and with a prominent fishery in the region of the Gulf of Panama).

Third Quarter: Principally on the local banks, and off Ecuador and Peru (the Guayaqail bank and ridge).

Fourth Quarter: Much as in the third quarter but probably less specific as to area.

(Raymond C. Griffiths—Inter-American Tropical Tuna Commission Bulletin—Vol. IV No. 3).

(ii) Pink Salmon Tagging programme

A co-operative Pink Salmon tagging programme, the largest ever attempted for Pacific Salmon is being conducted from July 1959. This programme, jointly conducted by the Fisheries Research Board of Canada, the International Pacific Salmon Fisheries Commission and the Washington State Department of Fisheries is to determine the migratory movements of Pink Salmon stocks which pass through convention waters on their way to spawning streams in Southern British Columbia and Puget Sound.

About 57,000 Pinks are proposed to be tagged of which Canada will tag up to 25,000, Salmon Commission up to 30,000 and the State of Washington up to 2,000. This programme stems from the requirement outlined in 1957 Pink Salmon Protocol agreement between Canada and the United States, under which a Committee appointed scientists from the participating agencies to prepare a co-ordinated investigational programme based on the analysis of all available data.

This survey of Pink Salmon populations, along with information that will enable segregation of individual stocks, will provide a description of how various stocks migrate through the area under study and measure the contribution of each stock to the various fisheries.

(Trade News—September, 1959 p. 14).

(iii) Stains Used to Mark Shrimp for Migration Studies

Techniques for marking shrimp with vital stains which permit them to molt and retain the mark have been developed by the U.S. Bureau of Commercial Fisheries. Using this method the Scientists stained juvenile pink shrimp and recaptured them four months later at a distance of more than 100 miles away from the original place. During this period it was seen that they had tripled their weight.

(Commercial Fisheries Review—Vol. 21. No. 9—Sept., 1959)

Hydrobiology

(i) The Physical Oceanography of the Gulf of Nicoya, Costa Rica, a tropical estuary

Distributions of salinity, temperature and oxygen in the Gulf of Nicoya based on approximately bimonthly surveys between the period March 1952 to December 1957 have been examined.

The Gulf of Nicoya may be regarded as an estuarine system in which the dynamic structure is principally controlled by salinity variations. During the rainy season, run off in the upper reaches of the Gulf forms a seaward surface flow which must be compensated by a replenishment of saline water from below in order to maintain the salinity distribution. The entrained water is replaced by means of an up-inlet flow at deeper levels, of relatively more saline water.

The salinity structures observed during the year can be classified under two main groups, corresponding to the rainy and dry seasons. During the rainy seasons the Gulf is highly stratified and the horizontal gradient is strongly developed. With the decline of run off at the end of the rainy season, winds and tides destroy the highly stratified salinity structure characteristic of the rainy season resulting in an essentially oceanic salinity structure.

The seasonal changes in the temperature structure of the Gulf closely follow those of salinity; that is stratification is negligible during the dry season but highly developed in the rainy season.

The minimum temperature at all depths is reached in October or November, in phase with the period of minimum air temperature, whereas the period when the water column is warmest lags a month or so after the period of highest air temperature. The seasonal variation in the mean temperature of the water column rarely exceeds 3°C.

The seasonal distribution of dissolved oxygen is similar to that of temperature and salinity; that is, the oxygen concentration gradient is marked in the rainy season and negligible in the dry season.

An analysis of the heat budget was made to determine whether or not the temperature changes in the Gulf could be explained entirely in terms of heat exchanges with the atmosphere. The data indicate that the sea is continuously gaining more heat from the atmosphere than it is losing to the latter, so that, in order that the heat balance be maintained, there is indicated an advection of warm water from the Gulf is at a maximum during the rainy season, it is proposed that this loss of heat is largely due to the sea-ward flow of warm brackish water during this season.

(C.L. Peterson—Inter-American Tropical Tuna Commission Bulletin—Vol. IV. No. 4. 1960)

(ii) Studying the Oceans

During the year two Royal Australian Navy frigates, H.M.A. Ships *Diamantina* and *Gascoyne,* which had been equipped with laboratories, were engaged on oceanographical surveys of the eastern section of the Indian Ocean and of the Tasman and Coral Seas.

In preparation for the rapid determination of the salt content in the hundreds of sea-water samples taken during a cruise, a highly sensitive salinity meter was designed. This instrument allowed the determinations to be done in a fraction of the time taken by analytical methods, and with very much greater accuracy. Already it has been possible to show that the bottom water in the Coral Sea Basin and the Solomon Trench came from the East Australian Basin, and not as previously thought, from the Central Pacific.

These cruises were the first extensive deep-sea surveys made by Australian Scientists. Sea-water samples were taken from various depths at about 100 stations for chemical analyses for the measurement of basic production chlorophyll, phytoplankton, and zooplankton. These measurements indicate the type of water, circulation of water masses, and the association between water types, organisms, and fish occurences.

(Division of Fisheries & Oceanography, C.S.I.R.I. 1959-60)

Fishing Gear and Craft

(i) One-Boat Midwater-trawling experiments in the North Sea

Although midwater trawling is already a well established method in several countries, the methods employed appear to be still far from perfect. While commercial midwater trawling is mainly conducted with two boats (pair trawling), certain fishery conditions make the use of only one boat desirable. The use of otter boards for maintaining the horizontal net opening in one boat midwater trawling opens new possibilities.

The present trials were an attempt to develop one-boat midwater trawling for German Cutters—boats upto 24 m., L.O.A. and 180 H.P. and deep sea trawlers of about 400 B.R.T. and 600 to 800 H.P., and at the same time to test new means for two. The main problems of midwater trawling in general, namely:—

(1) accurate, reliable and continuous control of the working depth of the trawl during fishing;

(2) accurate and quick adjustment of the trawl to the actual depth of the fish, which is not necessarily the same when the net arrives as it was when the trawler passed over.

The basic solution of these problems was found by combining a high opening nylon trawl net with hydrofoil otter boards and an echo-sounding unit as depth gauge.

The high opening nylon net made of thinnest possible twines for low towing resistance allows for the largest possible size for a given engine output and towing speed. It was found that the opening height is of particular importance. For the Bank Herring off the Norwegian coast it should not be less than about 10 m, and the towing speed must exceed 3·5 knots. Comparison of the catches of a heavy and a light net proved that thin net twines are needed to keep the stow in the net opening as low as possible to avoid a frightening effect on the fish.

The hydrofoil 'suberkrub'—otter boards combine a high shearing action with low towing resistance, leaving as much power as possible for towing a larger net. By a special adjustment, *i.e.* the point of attachment of the warps located somewhat above the centre line of the board and an appropriate amount of weight at the lower edge, an upward component of shear is obtained, the amount of which is very sensitive to the towing speed. This adjustment makes it possible to effect a considerable change in working depth of about 30 m. and eventually even more by modification of the towing speed only, and only for larger changes the warp length has to be altered.

The echo-sounding method was found highly superior to all the other depth gauges tested so far. It consists basically of an echo sounder transducer mounted on the headline of the net which is connected by cable to the echo-sounding unit in the wheelhouse of the trawler. This transducer sounds vertically, either only downwards, or, and this measures the value of this method considerably, simultaneously or alternatively downwards and upwards. This echo-sounding depth gauge gives not only the distance of the net from the bottom and/or from the water surface, but also the groundrope of the net indicating the opening height and eventual foulings and the distribution of the fish in, below and/or above the net opening.

This new combination of a one-boat midwater trawl gear, the design and operation of which is throughly described, makes for the first time real 'aimed' fishing possible. The skipper has a continuous control over the position of his gear and its relation to the fish schools, and he has convenient possibilities for a quick and accurate adjustment of the gear to the fish.

Experimental catches and comparisons of the catches of a cutter operating the gear on a commercial scale with the catches of equal boats using the conventional methods are most promising. This method is therefore, considered well suitable to establish midwater trawling also for larger craft as a valuable means to improve the economy of trawling.

(J. Scharfe. Fisheries Technologist, Fishing Gear Section, F.A.O., Rome)

(ii) New Fisheries Research Vessel

A new vessel to assist in research for the Barracouta fishing industry the FRV Thyrsites—was completed and launched in Melbourne in November, 1959. The Vessel is 42 ft. in length, of all-steel construction, has diesel engines and

is equipped with echosounding devices. It was built by the Acro Steel Works Melbourne and its construction was financed with the cooperation of the Commonwealth Department of Primary Industry from the Fisheries Development Trust Fund. The Department of Primary Industry is also contributing £.3500 per year from the Fund for 5 years towards the running costs of the vessel.

The *Thyrsites* will make eight cruises a year in Bass strait, and will enable officers of the Division of Fishing and Oceanography to study the feeding, spawning and migratory habits of the Barracouta.

(Commonwealth Scientific and Industrial Research Organisation—Commonwealth of Australia—1959-60).

(iii) Factors affecting trawl door spread

Experiments have been carried out on the Pacific Coast by the U.S. Bureau of Commercial Fisheries on the factors which affect trawl door/spread at varying depths. The vessel used for this research was a 75 ft. Trawler of local design, powered by 180 h.p. engine and towing a 400 mesh eastern trawl with a 71 ft. head rope and 94 ft. ground rope. The doors were 3 ft. by 6 ft. and each weighed 550 lbs. being connected to the wings by 7 fathom extension.

It was found that, when using the usual warp length to depth ratio of 3-1, a wider spread was obtained at greater depth. At greater depths the drop of the warp, by virtue of its weight, resulted in a more horizontal pull. The conclusion is that extra warp should be paid out in shallow water. The spread was found to be reduced when speed was increased, specially in shallow water. The forces acting on the doors are varied by the weight of catch; or increased drag of the net, and this, too, was found to decrease the spread at a slight but constant rate.

The report concludes that the main factor affecting door spread is the degree of contact between the door and the bottom, which is affected by above mentioned factors. While this has long been the belief of practical fishermen, the information on warp angles and conformation provided by these tests will inevitably be welcomed by all trawlermen.

(World Fishing—Vol. 9. No. 3 March 1960)

INLAND FISHERIES RESEARCH

Fishery Biology

(i) Resistance to ulcer disease and ferunculosis in eastern brook trout, Salvelinus fontinalis

Four different strains of brook trout were exposed to infection with organisms causing either ulcer disease or ulcer disease and ferunculosis. Observations were made for periods ranging from 1 to 7 months. In the susceptible strains of brook trout, experimental infections caused faster progressing diseases and higher mortalities. Mortalities occurred at similar rates, whether ulcer disease was present alone or with ferunculosis. There was also a correlation, real or apparent, between weight gain of trout and their resistance to disease, the slower growing fish appearing to be more resistant.

(The Progressive Fish Culturist—Vol. 22. No. 3, July 1960)

(ii) Some effects of oxygen in relation to temperature on the development of lake trout embryos

Lake trout embryos were exposed to dissolved oxygen levels approximating 2·5, 3·5, 4·5 and 10·5 p.p.m. at each of four temperatures 2·5°C, 5·0°C, 7·5°C and 10·0°C, from fertilization to a lake stage of development.

The three low oxygen levels caused retardations in the developmental rates resulting in delayed hatching and lengthening of the hatching period, reduction vitelline circulatory structures and abnormalities of head and trunk. The low oxygen levels at 10°C caused total mortality just prior to hatching. These results are discussed and compared with previous findings.

(E.T. Garside—Can. J. Zool. Vol. 37 (1959))

(iii) Effects of injected Gonadotrophins on maturation and spawning of Blueback Salmon

Experiments conducted with various types of gonadotrophic substances to determine whether the maturation and spawning of adult Blueback Salmon could be accelerated by their use are presented. Several types of gonadotrophic materials like pituitary glands from Chinook salmon; Chum salmon and carp (Cyprinus carpio); mammalian gonadotrophin derived from anterior lobe of horse pituitary and estradiol were used. The results showed that only the Salmon pituitary glands produced some accelerating effect on maturation and secondary sex characteristics while others had no effect either on the time of spawning or on the development of secondary sex characteristics.

(B.D. Combs and R.E. Burrows—The Progressive Fish-Culturist Vol. 21. No. 4 October, 1959.)

Fishing Gear and Craft

(i) A special mount for an outboard motor

With a 5·5 horsepower outboard motor mounted 6 inches above the normal position and the tilt—adjusting bar of the motor set on release, a 12-foot aluminium boat can be used in very shallow water.

The mount is made of 1·75 by-9-by 15 inches wood (fir,) painted to match the boat. The mount is attached to the stern with four 0·25-inch stove bolts, fastened down with wing nuts. Flat washers are used on both ends of the bolts. For easier insertion and removal of the bolts, the holes in the stern are slightly larger than the diameter of the bolts. Short 0·25 inch bolts and nuts are used to plug holes below the water-line after the mount is taken off.

Because of turbulent air around the propeller, only low speeds can be maintained with the motor raised. For higher speeds in deeper waters, the motor must be in the normal position. To change without going ashore, the motor is taken off the mount, the mount is detached, bolts are inserted as plugs (if necessary) below the water line, and the motor is attached to the stern in the normal position. A safety chain is attached to the motor at all times.

(The Progressive Fish Culturist—Vol. 22 No. 1, Jan. 1960).

FISH PRESERVATION

DRYING

(i) Artificial Drying of Fish in Africa

Sun drying of fish is the traditional method, but it is a process which is largely dependent on the vagaries of weather and particularly unsatisfactory during the rainy season. Dr. R. Kreuzer, Chief of the Fish Processing Section of Fisheries Division of F.A.O. experimented in Africa to devise artificial method of fish drying. The results of the experiment was a batch of prime quality artificially dried fish. The process thus has great possibilities of expansion in the trade.

(Trade News Vol. 12 No. 4 Oct, 1959)

GENERAL FISHERY NEWS

International Indian Ocean Expedition

Indian ocean is the least explored amongst all oceanic regions and presents scientific problems of great interest. Exploration of its resources would also bring benefit to many countries particularly those bordering this ocean. Many international organisations interested in oceanography have emphasised the need for detailed oceanographic work in this part of the world, but a positive shape for such studies was given by the Special Committee of Oceanic Research of the International Council of Scientific Union which at its New York meeting in September, 1959, endorsed a proposal that research vessels belonging to all nations interested in the problem might make a concerted effort during the 1961-62 period to collect data on physico-chemical, biological, meteorological, geological and other aspects of oceanography, working in a regular sequence so that all parts of the ocean and most times of the year will be adequately covered. The results of such work would be pooled together and made available for more extended work of particular problems of scientific or economic importance which might come up as a result of these studies. In order to frame a cruising programme which will give the best results, it is proposed that existing cruising programmes for the 1960 and to some extent 1961, could be used and for this period, research vessels belonging to the United States, the Soviet Union, Australia, Great Britain etc. are scheduled to join.

This project is now only in the planning stage. The actual expedition may take place only in the 1962-63 period.

It has been agreed that all ships should work on a few representative problems and in groups and that joint provision be made for preserving and sorting the data and the biological collections so that recognised specialists could call on material from all parts of the ocean and depths in different seasons. India has special interest in the project because of her geographical position. The expedition might open up important fishery resources in the utilisation of which India is vitally concerned. The onset and withdrawal of monsoons and connected meteorological phenomena are closely connected with the changes in winds and currents taking place in the ocean. There are also many other scientific problems like deep sea tides, sea level changes, radio activity of waters, air-ocean inter-relationship, surface and sub-surface current measurements, oceanic population and productivity, life histories of marine organisms and accurate sounding of the ocean, all of which are of interest to us.

The 1960 International Conference—Safety of life at Sea

The 1960 International Conference on Safety of Life at Sea, held in London from May, 17 to June, 17, was the fourth International Conference on this subject and the first to be convened by the Inter-Governmental Maritime Consultative Organisation (IMCO), the United Nations Agency which deals with maritime matters. The aim of the Conference was to review and revise, in the light of technical and scientific advances, the existing International Convention for the Safety of Life at Sea, which was drawn up in 1948. Some of the changes adopted by the Conference are reviewed.

The Conference decided not to extend the provisions of the Convention to fishing vessels, but Governments are recommended as in 1948, to apply the provisions of the Convention as far as is reasonable and practicable both to fishing vessels and to smaller cargo ships. A regulation concerning stability information, which applies to passenger and cargo ships under the 1948 Convention has not been extended to fishing vessels. Certain proposals to include fishing vessels in radio safety measures were not adopted.

(Ship and Boat Builder and Naval Architect—July, 1960)

Boats Most Costly Part of Fishing: New F.A.O. Book issued

According to a book published "Fishing Boats of the World" the investment in fishing boats in highly-developed countries runs higher than the investment in harbours, canning plants and retail stores together. A survey by the Canadian Government in 1958 showed vessels accounted for 67 per cent of the total investment in the Canadian fishing industry.

The largest book to be sponsored by F.A.O., edited by Jan-Olof Traung, Chief of F.A.O.'s Fishing Boat Section, the book is based on the papers and discussion on the Second F.A.O. World Fishing Boat Congress but includes all recent developments in fishing boats, from their design and construction to insurance. It is written in English with French and Spanish abstracts.

Chapters and Charts are devoted to dock design, scantlings, fish holds, machinery, costs, sea behaviour, safety at sea, boat types and choosing the right craft for the task. A special feature is a discussion of the fishing boats of 1975.

Among the charts presented is a table showing the principal fishing boat types used in each country. These countries accounted for 92 per cent of the world's fish catch.

Japan has 14 individual major types of fishing boats, followed by the U.S.S.R. with 11 and Norway with 10; the U.S.A. have a different major types; the U.K., Canada and Iceland list a total of 7 ship types; Portugal, France, Sweden and India, Six each; The Faroes, Germany, the Netherlands and Italy 5; Denmark, Indonesia and the Union of South Africa, 4.

The most popular boat in use is the trawler, used by 35 nations. Then comes the drifter, employed by 29 nations, followed by the purse seiner used by 26 nations. The troller is used by 12 nations and the whale catcher by 11.

One of the many subjects covered is the recent trend to stern trawling rather than side trawling. While trawling is regarded as the most advanced method of fishing, book says that other methods are constantly improving. Information supplied by the Japanese show that the use of long-line gear is a productive method of fishing.

The book points out that most boats today are still small—between 80 and 90 ft. in length but too heavy and not costing more than $ 100,000. Generally built of wood, they are constructed on the principle of the thicker the timber the safer the boat. The studies published in the book show Danish boats to be 40 per cent and Swedish boats 30 per cent heavier than necessary. A detailed discussion of a new type of British Commercial Stern trawler, which recently went into commercial fishing for the first time included in the volume.

(Food and Agriculture Organisation of the United Nations)

Advanced training of Central Fisheries Officers

Shri K. Virabhadra Rao who was deputed to Japan for specialised training in Molluscan fisheries returned to India in September, 1960. Shri S. K. Banerjee, Research Officer (Fishery Survey) was sent to U.S.A. for advanced training in Fisheries Statistics under T.C.M. and he returned to India in March, 1960. Dr. R. Viswanathan, Assistant Research Officer (Oceanography) participated as a trainee in the International Training Course in the use of Radio Isotopes in Agricultural Research at New Delhi.

Shri K. H. Alikunhi of the Central Inland Fisheries Research Station, Cuttack deputed for training in Japan under the Colombo Plan returned to India in September, 1959 after a period of successful training.

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